Title: Hit Me If You Can!

Brief Overview:

This lesson is designed to help students learn to use the CBL and the motion detector. Using the CBL, TI-82 and motion detector, students will see that the speed and direction of their own body over time creates a different slope line. This can lead to discussions of linear equations, specifically positive, negative, and zero slopes. After this lesson, students should have a better idea of slope and y-intercept.

Link to Outcomes:

- **Mathematics as Problem Solving**
  Students will attempt to "hit" a point in the first quadrant by physically moving and varying speed in front of a motion detector. This motion will generate a line to be analyzed for slope and y-intercept.

- **Mathematical Connections**
  Students will analyze the relationships between slope and speed and between y-intercept and starting position.

- **Number and Number Relationships**
  Students will see that numbers do have a place in the real world specifically speed and direction equating to the slope of a line.

- **Algebra**
  Students will apply their knowledge about linear equations: $y = mx + b$.

Grade/Level:

Grades 8 - 11, Pre-Algebra, Algebra I

Duration/Length:

This activity will take 1 or 2 class periods to complete.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Basic use of the TI-82
- Plotting points in the coordinate plane and graphing linear equations
- Determining the slope and y-intercept of a given line

Objectives:

Students will be able to:

- work cooperatively as a class.
- collect and organize data from CBL, TI-82, and motion detector.
- analyze linear graphs and calculated values to make real-world conclusions about slope and y-intercept.

Materials/Resources/Printed Materials:

- TI-82, CBL, motion detector
- Student worksheet
- Teacher resources

Development/Procedures:

- Lab Set Up:
  1. Set up the CBL, TI-82, motion detector shown in the diagram on the student lab worksheet.
  2. Clear the TI-82 calculator in the Y = menu.
  3. Turn on the CBL unit and the calculator. Follow the directions given in the student worksheet.

- Lab Introduction
  1. Show students the equipment, explaining how it is going to be used.
  2. Follow the directions on the student worksheet.

Evaluation:

- The student should complete the worksheet and conclude with a working knowledge of slope and y-intercept.
- The student should list real-world conclusions about his/her graphs.
- The worksheets will be collected and evaluated.

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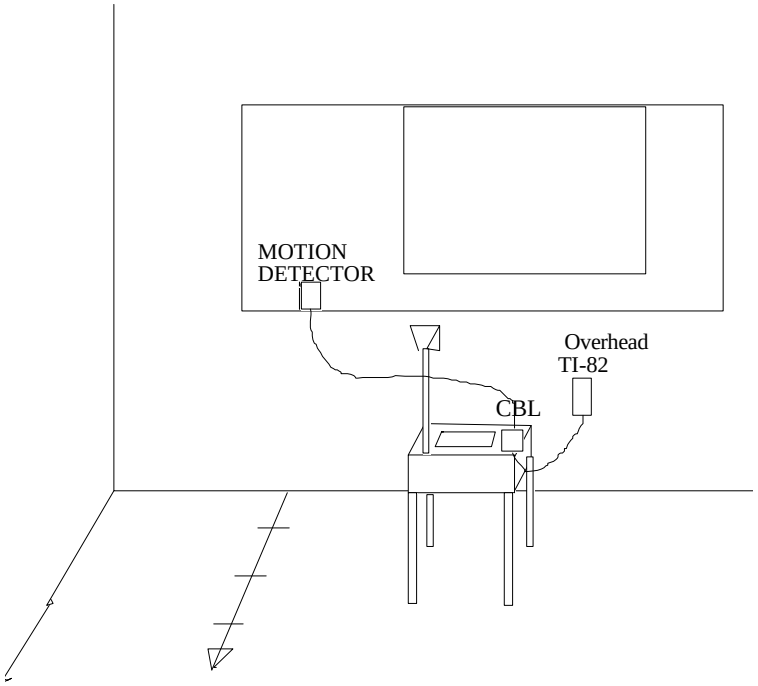
TEACHER INSTRUCTIONS

1) Connect the Motion Detector to the CBL via the sonic port and the overhead TI-82 to the CBL with the link cable. The motion detector can be taped to the blackboard or set on the chalk rail aimed at the waist of an average student. Straight out from the motion detector, clear a path reaching 2 - 6 meters into the classroom . You may want to mark off 1, 2, 3, ... meters on the floor for assistance in hitting the target.



2) Run the program HITME on the overhead TI-82. (HITME is derived from the program MATCH IT out of *Real-World Math with the CBL System*, by Texas Inst.)

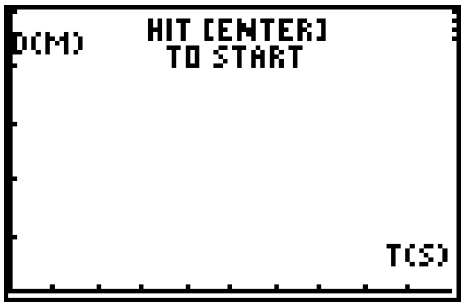
3) Follow the directions on the TI-82 screen to complete the lab.

STUDENT WORKSHEET

1) Run the HITME program and follow the instructions.

2) Try two times to hit a target, sketching below each attempt. **Note** that the scale markers on the vertical axis of the graph are ½ meter marks.

Attempt # 1:



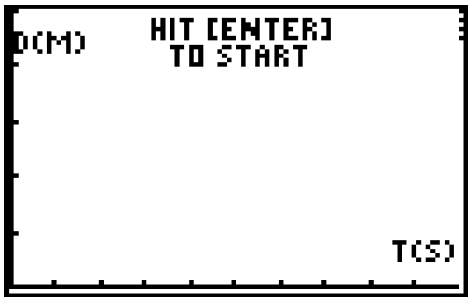
A) Explain your movement.
_____

B) How did your speed and direction effect the graph?
_____

C) How did your starting position effect the graph?
_____

D) What should you have done to hit the target?
_____

Attempt # 2:



A) Explain your starting position and movement.

_____

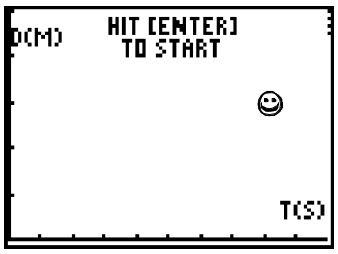
B) Were you closer to the target this time? If not, what should you have done?

_____

3) After observing how motion effects your graph, respond to the following.
   A) How does the speed at which you move away from the motion detector affect the graph? _____
   B) In the equation y = mx + b, **m** is called the _____. As you move away from the motion detector, the slope is _____(positive or negative). As you move toward the motion detector, the slope is _____.

C) In the equation y = mx + b, **b** is called the _____. What effects **b**?_____

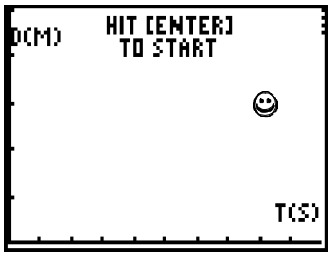
4) Following a straight line path, show three ways to hit the target and describe the physical movement.



Use a positive sloped line to hit Smiley.

Describe the physical movement.

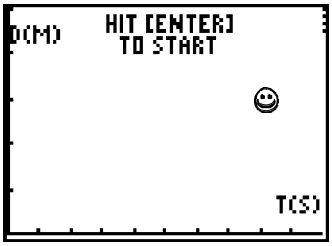
_____



Use a negative sloped line to hit Smiley.

Describe the physical movement.

_____

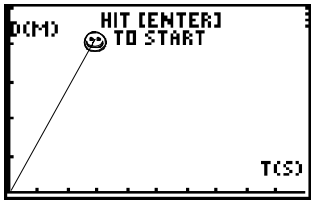


Use a zero sloped line to hit Smiley.

Describe the physical movement.

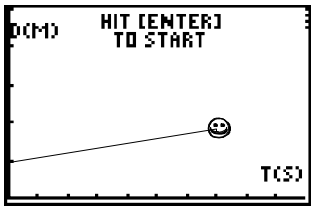
_____

5) Now, **given** the graph to the target, describe the physical movement and find the values of m and b so as to write the equation y = mx + b.



Physical movement:_____

m = _____
b = _____
y = _____

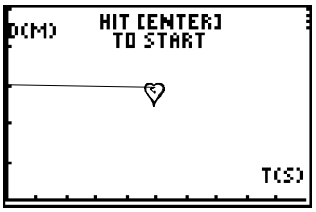


Physical movement:_____

m = _____

b = _____

y = _____

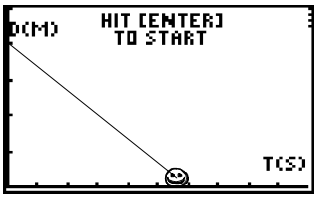


Physical movement:_____

m = _____

b = _____

y = _____



Physical movement:_____

m = _____

b = _____

y = _____

6) The Million Dollar question:
From this lab, what are the physical descriptions for slope and y-intercept?

Slope <==> _____

Y-intercept <==> _____

TI-82 Program “Hit Me”

```
:Normal
:Connected
:FullScreen
:Func
:Float
:RectGC
:CoordOn
:GridOff
:AxesOff
:LabelOff
:PlotsOff
:FnOff
:ClrDraw
:0→Xmin
:99→Xmax
:0→Ymin
:62→Ymax
:Text(43,16,”HIT ME IF YOU CAN”)
:Text(57,6,”PRESS    [ENTER] TO START.”
:Pause
:Menu(“***OPTIONS***”,”COLLECT DATA”,1,”QUIT”,2)
:Lbl 2
:ClrHome
:Stop
:Lbl 1
:ClrHome
:
:Disp “USE UNIT-TO-UNIT”
:Disp “CORD TO LINK THE”
:Disp “CBL AND TI-82.”
:Output(4,10,“[ENTER]”)
:
:Pause
:ClrHome
:
:Disp “PLUG THE MOTION”
:Disp “DETECTOR INTO”
:Disp “CBL SONIC PORT”
:Output(4,1,”ON SIDE. [ENTER]”)
:Pause
:FullScreen
:ClrHome
:
:Disp “TURN ON THE CBL.”
:Output(4,10,”[ENTER]:)
:Pause
:FullScreen
:ClrHome
:Disp “NOW CHECKING THE”
:Disp “CALCULATOR-CBL”
:Disp “LINK CONNECTION.”
:Disp “PLEASE WAIT. . . .”
:{1,0}→L
:Send(L )
```

```
:{0}→L2
:Lbl M
:{7}→L
:Send(L )
:Get(L2)
:If dim L2=1 and L2(1)=0
:Then
:ClrHome
:Disp "***LINK ERROR***"
:Disp "PUSH IN THE LINK"
:Disp "CORD CONNECTORS:
:Disp "FIRMLY THEN HIT"
:Disp "[ENTER]."
:Pause
:Goto M
:End
:Disp ""
:Output(6,1,"     STATUS: O.K."
:Output(8,10,"[ENTER]")
:Pause
:FullScreen
:ClrHome
:Disp "TRY TO MOVE IN"
:Disp "FRONT OF THE"
:Disp "MOTION DETECTOR"
:Disp "TO DIRECTLY"
:Disp "HIT THE TARGET"
:Disp "ON THE SCREEN."
:Output(8,1,"         [ENTER]")
:Pause
:Lbl H
:FullScreen
:PlotsOff
:FnOff
:Func
:AxesOn
:0→Xmin
:99→Xmax
:0→Ymin
:2.5→Ymax
:10→Xscl
:.5→Yscl
:ClrHome
:
Lbl Q
:int (100*rand)→K
:If (K≥99 or K<90):Goto Q
:
:

:Lbl R
:(int (10*rand(2.5)))/10→N
:If (N≥2.5 or N<.5):Goto R
:Lbl 0
:{1,0}→L
:Send(L )
```

```
:{1,11,2}→L
:Send(L )
:ClrDraw
:Text(4,1,“D(M)”)
:Text(51,81,“T(S)”)
:
:
:Text(1,30,“HIT [ENTER]”)
:Text(7,34,“TO START”)
:Pt-On(K,N)
:Pause
:Text(1,30,“                                    ”)
:Text(7,34,“                              ”)
:
:Text(1,30,“                                  ”)
:Text(7,34,“                           ”)
:{3,.1,-1,0}→L
:Send(L )
:99→dim L4
:For(I,1,99,1)
:Get(L4(I))
:Pt-On(I,L4(I))
:End
:L4→L2
:ClrList L4
:Pause
:Menu(“***OPTIONS***”,“SAME MATCH”,0, “NEW MATCH”,H,“QUIT”,8)
:Lbl 8
:seq(X,X,0,9.8,.1)→L
:Lbl P
:0→Xmin
:0→Ymin
:2.5→Ymax
:.5→Yscl
:9.8→Xmax
:1→Xscl
:PlotsOff
:FnOff
:ClrDraw
:Plot1(Scatter,L ,L2,•)
:DispGraph
:Text(4,1,“D(M)”)
:Text(51,81,“T(S)”)
:StoreGDB GDB6
:0→U
:0→V
:Stop
```